

- 36 -

CLAIMS

1. Method of load balancing in a wireless communication network, said wireless communication network comprising
at least one subscriber terminal (T1, T2, T2) adapted to establish and perform a wireless communication connection in said wireless communication network,

a plurality of access points (AP1, AP2, AP3) adapted to control said wireless communication connection of said at least one subscriber terminal and to exchange information with said at least one subscriber terminal, wherein one of said plurality of access points is

associated with said at least one subscriber terminal, and
a load control device (21; 110) located outside of said subscriber terminal, said load control device being adapted to process information related to a load in said wireless communication network and to instruct roaming of said subscriber terminal from said associated one of said plurality of access points to another one of said plurality of access points,

said method comprising the steps of
receiving, in said subscriber terminal, access point status information (APST) determined in said plurality of access points (S10; S110), determining communication status information related to said plurality of access points (S20; S120), and processing (S20; S120) said received access point status information and said communication status information in order to obtain roaming support information (RSUP),

processing (S40; S160), in said load control device, said roaming support information by an access point related load based roaming analysis and deciding (S50; S170), on the basis of a result of said access point related load based roaming analysis, whether said subscriber terminal is to be associated with another one of said plurality of access points, and if so,

- 37 -

initializing (S60; S180) roaming of said subscriber terminal to said another one of said plurality of access points in said wireless communication network.

2. Method according to claim 1, wherein said access point status information (APST) comprises an access point identification element and an access point load status indicator determined in a respective access point.

3. Method according to claim 1 or 2, wherein, in said step of determining communication status information, a received signal strength indicator (RSSI) indicating the received signal strength of said plurality of access points is determined.

4. Method according to any of claims 1 to 3, wherein, in said step of determining communication status information, a carrier to interference ratio (C/I) per each access point is determined.

5. Method according to any of claims 1 to 4, wherein, in said step of determining communication status information, a terminal transmit power status is determined.

6. Method according to any of the preceding claims, wherein said roaming support information (RSUP), obtained in said step of processing said received access point status information and said communication status information, comprises statistics of access point related communication status and load information derived from said received access point status information.

7. Method according to any of the preceding claims, wherein in said step of processing, in said load control device, said roaming support information by said access point related load based roaming analysis, a hand-off algorithm

- 38 -

is used to calculate load and connection quality situations for said plurality of access points on the basis of said roaming support information and to determine an optimal access point for being associated with said subscriber terminal.

8. Method according to any of the preceding claims, wherein processing parameters used in said access point related load based roaming analysis and derived from said roaming support information (RSUP) are differently weighted in said access point related load based roaming analysis.

9. Method according to any of the preceding claims, wherein said load control device (21) is located in at least one of said plurality of access points.

10. Method according to any of claims 1 to 8, wherein said load control device (110) is located in a network element (100) separated from said plurality of access points, said network element being connected with said plurality of access points in said wireless communication network.

11. Method according to claim 10, further comprising the steps of

transmitting (S140) access point internal monitoring information (APIM) from said plurality of access points to said load control device (110) in said network element,

determining (S150), in said load control device, access points available for said subscriber terminal and selecting access point internal monitoring information of said available access points,

processing (S160), in said load control device, said roaming support information (RSUP) and said selected access point internal monitoring information (APIM) by an enhanced access point related load based roaming analysis and deciding (S170), on the basis of a result of said enhanced

- 39 -

access point related load based roaming analysis, whether said subscriber terminal is to be associated with another one of said plurality of access points, and if so,

initializing (S180) roaming of said subscriber terminal to said another one of said plurality of access points in said wireless communication network.

12. Method according to claim 11, wherein said access point internal monitoring information (APIM) comprises at least one of a retransmit rate to associated subscriber terminals, back-off windows, and a net allocation vector for a respective one of said plurality of access points.

13. Method according to any of claims 11 to 12, wherein processing parameters used in said enhanced access point related load based roaming analysis and derived from said roaming support information and said selected access point internal monitoring information are differently weighted in said enhanced access point related load based roaming analysis.

14. System for load balancing in a wireless communication network, said wireless communication network comprising

at least one subscriber terminal (T1, T2, T2) adapted to establish and perform a wireless communication connection in said wireless communication network, and

a plurality of access points (AP1, AP2, AP3) adapted to control said wireless communication connection of said at least one subscriber terminal and to exchange information with said at least one subscriber terminal, wherein one of said plurality of access points is associated with said at least one subscriber terminal,

said system comprising

access point load status monitoring means (11, 12, 13; 111, 112, 113) located in each one of said plurality of access points and adapted to measure a traffic load of an

- 40 -

access point and to transmit access point status information (APST),

roaming support means (30; 300) located in said subscriber terminal and adapted to receive said access point status information from said plurality of access points, to determine communication status information related to said plurality of access points, to process said received access point status information and said communication status information in order to obtain roaming support information (RSUP), and to transmit said roaming support information, and

a load control device (21; 110) located outside of said subscriber terminal, said load control device being adapted to process said roaming support information by an access point related load based roaming analysis, to decide, on the basis of a result of said access point related load based roaming analysis, whether said subscriber terminal is to be associated with another one of said plurality of access points, and to initialize roaming of said subscriber terminal from said associated one to said another one of said plurality of access points in said wireless communication network.

15. System according to claim 14, wherein said access point status information (APST) comprises an access point identification element and an access point load status indicator determined in a respective access point.

16. System according to claim 14 or 15, wherein said roaming support means is adapted to determine a received signal strength indicator indicating the received signal strength of said plurality of access points.

17. System according to any of claims 14 to 16, wherein said roaming support means is adapted to determine a carrier to interference ratio per each access point.

- 41 -

18. System according to any of claims 14 to 17, wherein said roaming support means is adapted to determine a terminal transmit power status.

19. System according to any of claims 14 to 18, wherein said roaming support information obtained in and transmitted from said roaming support means comprises statistics of access point related communication status and load information derived from said received access point status information.

20. System according to any of claims 14 to 19, wherein said load control device is adapted to process said roaming support information in said access point related load based roaming analysis by using a hand-off algorithm to calculate load and connection quality situations for said plurality of access points on the basis of said roaming support information and to determine an optimal access point for being associated with said subscriber terminal.

21. System according to any of claims 14 to 20, wherein said load control device is adapted to differently weight processing parameters used in said access point related load based roaming analysis and derived from said roaming support information.

22. System according to any of claims 14 to 21, wherein said load control device (21) is located in at least one of said plurality of access points.

23. System according to any of claims 14 to 21, wherein said load control device (110) is located in a network element (100) separated from said plurality of access points, said network element being connected with said

- 42 -

plurality of access points in said wireless communication network.

24. System according to claim 21, said system further comprising

access point internal monitoring means (211, 212, 213) located in each one of said plurality of access points and adapted to determine access point internal monitoring information (APIM) and to transmit said access point internal monitoring information to said load control device,

wherein said load control device (110) is adapted to determine, from said access point internal monitoring information, access points available for said subscriber terminal and to select access point internal monitoring information of said available access points, to process said roaming support information and said selected access point internal monitoring information by an enhanced access point related load based roaming analysis, to decide, on the basis of a result of said enhanced access point related load based roaming analysis, whether said subscriber terminal is to be associated with another one of said plurality of access points, and to initialize roaming of said subscriber terminal from said associated one to said another one of said plurality of access points in said wireless communication network.

25. System according to claim 24, wherein said access point internal monitoring information comprises at least one of a retransmit rate to associated subscriber terminals, back-off windows, and a net allocation vector for a respective one of said plurality of access points.

26. System according to any of claims 24 to 25, wherein said load control device is adapted to differently weight processing parameters used in said enhanced access point

- 43 -

related load based roaming analysis and derived from said roaming support information and said selected access point internal monitoring information.

27. Load control device (21; 110) for load balancing in a wireless communication network, said wireless communication network comprising

at least one subscriber terminal (T1, T2, T2) adapted to establish and perform a wireless communication connection in said wireless communication network, and

a plurality of access points (AP1, AP2, AP3) adapted to control said wireless communication connection of said at least one subscriber terminal and to exchange information with said at least one subscriber terminal, wherein one of said plurality of access points is associated with said at least one subscriber terminal,

wherein said load control device is located outside of said subscriber terminal and adapted to process roaming support information (RSUP), received from a subscriber terminal and derived by said subscriber terminal from access point status information (APST) of said plurality of access points, by an access point related load based roaming analysis, to decide, on the basis of a result of said access point related load based roaming analysis, whether said subscriber terminal is to be associated with another one of said plurality of access points, and to initialize roaming of said subscriber terminal from said associated one to said another one of said plurality of access points in said wireless communication network.

28. Load control device according to claim 27, wherein said access point status information comprises an access point identification element and an access point load status indicator determined in a respective access point.

- 44 -

29. Load control device according to claim 27 or 28, wherein said roaming support information comprises at least a received signal strength indicator indicating the received signal strength of said plurality of access points.
30. Load control device according to any of claims 27 to 29, wherein said roaming support information comprises at least a carrier to interference ratio per each access point.
31. Load control device according to any of claims 27 to 30, wherein said roaming support information comprises at least a terminal transmit power status.
32. Load control device according to any of claims 27 to 31, wherein said roaming support information comprises statistics of access point related communication status and load information derived from said access point status information.
33. Load control device according to any of claims 27 to 32, wherein said load control device is adapted to process said roaming support information in said access point related load based roaming analysis by using a hand-off algorithm to calculate load and connection quality situations for said plurality of access points on the basis of said roaming support information and to determine an optimal access point for being associated with said subscriber terminal.
34. Load control device according to any of claims 27 to 33, wherein said load control device is adapted to differently weight processing parameters used in said access point related load based roaming analysis and derived from said roaming support information.

- 45 -

35. Load control device according to any of claims 27 to 34, wherein said load control device (21) is located in at least one of said plurality of access points.

36. Load control device according to any of claims 27 to 34, wherein said load control device (110) is located in a network element (100) separated from said plurality of access points, said network element being connected with said plurality of access points in said wireless communication network.

37. Load control device according to claim 36,

wherein said load control device (110) is adapted to receive access point internal monitoring information (APIM) of said plurality of access points, to determine, from said access point internal monitoring information, access points available for said subscriber terminal and to select access point internal monitoring information of said available access points, to process said roaming support information and said selected access point internal monitoring information by an enhanced access point related load based roaming analysis, to decide, on the basis of a result of said enhanced access point related load based roaming analysis, whether said subscriber terminal is to be associated with another one of said plurality of access points, and to initialize roaming of said subscriber terminal from said associated one to said another one of said plurality of access points in said wireless communication network.

38. Load control device according to claim 37, wherein said access point internal monitoring information comprises at least one of a retransmit rate to associated subscriber terminals, back-off windows, and a net allocation vector for a respective one of said plurality of access points.

- 46 -

39. Load control device according to any of claims 37 to 38, wherein said load control device is adapted to differently weight processing parameters used in said enhanced access point related load based roaming analysis and derived from said roaming support information and said selected access point internal monitoring information.

40. Access point (AP1, AP2, AP3) usable in a wireless communication network, said wireless communication network comprising at least one subscriber terminal (T1, T2, T2) adapted to establish and perform a wireless communication connection in said wireless communication network and further access points, said access point being adapted to control said wireless communication connection of said at least one subscriber terminal and to exchange information with said at least one subscriber terminal,

wherein said access point comprises

access point load status monitoring means (11, 12, 13) adapted to measure a traffic load of an access point and to transmit access point status information, and

a load control device (21) according to any of claims 27 to 35.

41. Network element usable (100) in a wireless communication network, said wireless communication network comprising

at least one subscriber terminal (T1, T2, T2) adapted to establish and perform a wireless communication connection in said wireless communication network, and

a plurality of access points (AP1, AP2, AP3) adapted to control said wireless communication connection of said at least one subscriber terminal and to exchange information with said at least one subscriber terminal, wherein one of said plurality of access points is associated with said at least one subscriber terminal,

- 47 -

wherein said network element (100) is separated from and connected to said plurality of access points and comprises a load control device (110) according to any of claims 27 to 34 and 36 to 39.

42. Subscriber terminal (T1, T2, T3) usable in a wireless communication network, said wireless communication network comprising

a plurality of access points (AP1, AP2, AP3) adapted to control a wireless communication connection of said subscriber terminal and to exchange information with said subscriber terminal, wherein one of said plurality of access points is associated with said subscriber terminal,

said subscriber terminal comprising

roaming support means (30; 300) adapted to receive access point status information (APST) from said plurality of access points, to determine communication status information related to said plurality of access points, to process said received access point status information and said communication status information in order to obtain roaming support information (RSUP), and to transmit said roaming support information to a load control device (21; 110) according to any of claims 27 to 39,

wherein said subscriber terminal performs, in response to an instruction from said load control device, roaming from said associated one to another one of said plurality of access points in said wireless communication network, said another one of said plurality of access points is indicated in said instruction from said load control device.

43. Computer program product usable for a data processing apparatus, comprising software code portions for performing the steps of claims 1 to 13 when said product is run on said data processing apparatus.

- 48 -

44. A computer program product according to claim 43, wherein said computer program product comprises a medium readable by said data processing apparatus, on which said software code portions are stored.

45. A computer program product according to claim 43, wherein said computer program product is directly loadable into an internal memory of said data processing apparatus.

46. A computer program product according to any of claims 43 to 45, wherein respective elements (11, 12, 13, 21, 30; 110, 111, 112, 113, 211, 212, 213, 300) of a system according to any of claims 14 to 26 represent said data processing apparatus.